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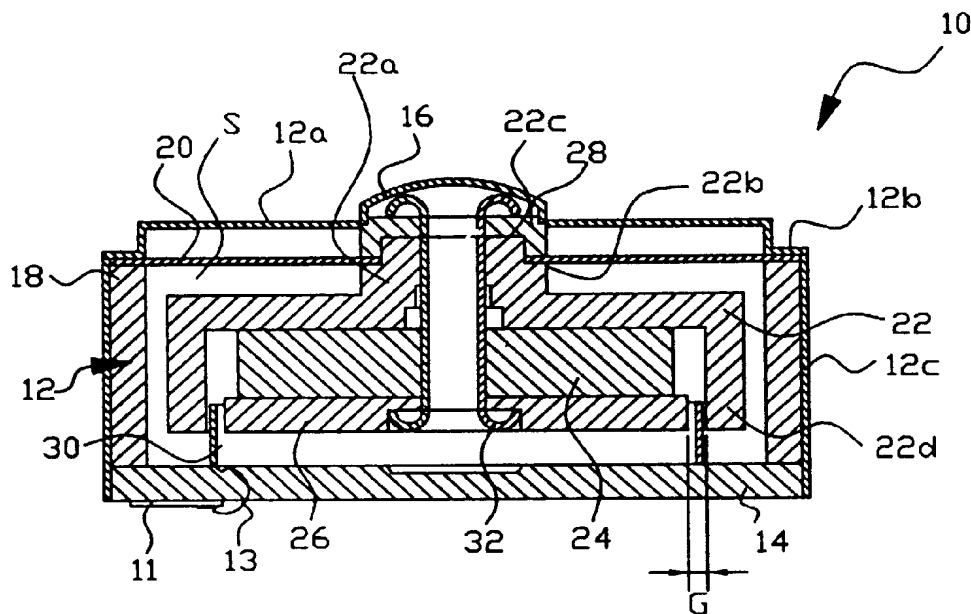
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(54) Title: SUBMINIATURE BONE CONDUCTION SPEAKER



(57) **Abstract:** The present invention relates to a subminiature bone conduction speaker which vibrates bones around human skull directly and stimulates auditory nerves through bone conduction in order to help sound to be heard. Vibrations are transmitted to a part of human head and its resulting vibration power makes sound heard through the bone conduction. The bone conduction speaker of the present invention can be applied to various fields such as mobile phone, wireless phone, earring-type mobile phone, telephone and the like since it can be made a subminiature easily and improves conventional bone conduction speakers. In addition, it keeps communication private by reducing sound discharges toward outside.



WO 02/25989 A1

**SUBMINIATURE BONE CONDUCTION SPEAKER**TECHNICAL FIELD

5           The present invention relates to a subminiature bone conduction speaker.

          More particularly, the present invention relates to a bone conduction speaker which vibrates bones around human skull directly and stimulates auditory  
10       nerves through bone conduction in order to help sound to be heard. The bone conduction speaker of the present invention can be applied to various fields such as mobile phone, wireless phone, earring-type mobile phone, telephone and the like since it improves conventional  
15       bone conduction speakers and can be subminiaturized easily. In addition, it keeps communication private by reducing sound discharges toward outside.

BACKGROUND ART

20           Generally, all information existing around us is delivered in a form of waves. For example, sound heard through ears, light entering into eyes, electromagnetic waves received by television and radio are transferred  
25       from sources to receivers by use of wave movement, without the movement of material between the two points.

          Sound heard through ears is a wave which is made

of vibrations in objects and a kinetic energy with a peculiar form which is generated by the movement of atoms in a regular pattern. Various sound equipments available in everyday lives exploit the kinetic energy of electrons when currents flow along the wire. The kinetic energy of electrons is a kind of electric energy and makes sounds in speakers. We can hear the sound of speaker when air vibrates the eardrum through the molecular movement.

Sound enters external auditory meatus (EAC), that is through ear pore, and vibrates the eardrum. Then cells of internal ear inside the eardrum are stimulated and the sound is transmitted to brain so as to be heard. Sound that humans can hear is in the range of 20 ~ 20,000 Hz and sound suitable for human audition is in the range of 125 ~ 8,000 Hz. Conversational sounds suitable for human dialogues are mainly in the frequency range of 500 ~ 2,000 Hz. Normal human beings can hear all the waves in between these frequencies but hearing-impaired people can not hear all the sounds or certain sounds with specific frequencies very well.

Recently, bone conduction telephones have been developed to help hearing-impaired or old people to communicate like normal people. The bone conduction telephone enables hearing-impaired or old people to speak without external auxiliary equipment by using bone conduction as a part of auditory sense. Namely,

ordinary telephones transform electric signals into sound signals through receivers consisting of speakers in order to hear it through ears. Meanwhile, the bone conduction telephone exploits an unfamiliar medical  
5 concept - bone conduction auditory sense - which enables hearing-impaired person damaged on external ear and middle ear to hear by ringing bones around auricula. When the bone conduction auditory sense is used, surrounding noises are removed effectively. Therefore,  
10 in noisy environment such as market, construction place and so on, general public can communicate excellently with these telephones as well.

Korean Patent Publication No. 96-7406 have disclosed that the bone conduction waver which enables  
15 deafness patient hear through auditory sense by bone conduction and also makes normal human beings hear sound signals through air way. Particularly, the bone conduction waver is equipped to fix a mastoid stimulating cranium directly on the upper end of voice  
20 coil and to vibrate a diaphragm by the interaction between fixed magnetic bar and magnetic field formed by the voice coil.

However, the bone conduction waver has some disadvantages as follows. Possibly, the leader line of  
25 voice coil is prone to be cut by oscillations. Moreover, in the case of reducing the size of the waver, the ratio that cuts occur increases since the

miniaturization is restricted by the interference of leader lines and then the power that the speaker generates is weakened. Besides, the bone conduction waver cannot keep communicational securities when used in correspondence with terminal equipments because it discharges sound to outside on account of structural problems.

#### DISCLOSURE OF INVENTION

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To overcome the foregoing and other disadvantages, the inventors of the present invention have tried to develop new bone conduction speaker.

It is an object of the present invention to provide a subminiature bone conduction speaker which vibrates bones around human skull directly and stimulates audition nerves through the bone conduction in order to help sound heard.

It is another object of the present invention to provide a bone conduction speaker which has disparable features from conventional bone conduction oscillators. Concretely, the present invention provides the bone conduction speaker which has a structure that a voice coil is fixed on a base plate; a magnetic circuit oscillating upward and downward is installed; and a mastoid for transmitting sound vibrations to outside is set on the upper end of the magnetic circuit.

Therefore, the bone conduction speaker of the present invention can be made to a subminiature and thus applied to various fields usefully. In addition, it can keep the communication security effectively since it seldom discharges sound to outside.

Further objects and advantages of the present invention will appear hereinafter.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which;

15

**FIG. 1** depicts a plane figure of the subminiature bone conduction speaker described in Preferred Embodiment of the present invention; and

20

**FIG. 2** depicts a sectional view of **FIG. 1** described across the line II - II.

\*\*\*\*\* Explanation of symbols in the figures \*\*\*\*\*

25

10: bone conduction speaker

11: electrode terminal plate

- 12: frame
- 14: base plate
- 16: mastoid
- 18: bushing
- 5 20: damper
- 22: yoke
- 24: magnetic bar
- 26: overhead plate
- 28: adaptor
- 10 30: voice coil
- 32: eyelet
- S: inner space
- G: space

15 BEST MODE FOR CARRYING OUT THE INVENTION

In order to accomplish the objects of the present invention, the present invention provide a bone conduction speaker which comprises as follows:

- 20 a frame which limits a certain space and is composed of an overhead layer, a side layer, a bottom layer and a shoulder forming stairs in a radiational type between said overhead layer and said side layer;

- 25 a vibration contact part which is installed in a central aperture part, protruded to upside against said overhead layer and touches a part of human head directly;

a bushing which is arranged vertically on the inner surface of said shoulder and on the overhead surface of said bottom layer and inserted to the interior part of said side layer;

5 a damper which is arranged between the inner surface of said shoulder and the overhead surface of said bushing with its radiated ends, supported with said bushing, and reduces oscillations or sound amplitude to be vibrated stably;

10 a yoke which is arranged within said space, composed of a body part inserted into an assembling aperture formed in the center of said damper and one body with said body part, equipped with an extension part elongated downward, supports the other end of  
15 said damper through said shoulder formed in said body part and concentrates magnetic flux;

a magnetic bar which is arranged at the inside of said radiated region in said extension part and has a close contact between its overhead surface and the  
20 bottom surface of said body part;

an overhead plate which is arranged at the inside of said extension part, composed of a magnetic circuit with said yoke and said magnetic bar and has a close contact between its overhead surface and the  
25 bottom surface of said magnetic bar;

a voice coil which is arranged in a space constructed with said overhead plate, both ends of



said magnetic bar and the inner surface of said extension part and fixes its lower end on said bottom layer; and

an adaptor which is arranged in between the uppest surface of said yoke and the inner surface of said vibration contact part and supports said vibration contact part for the fixation.

As demonstrated above, the bone conduction speaker of the present invention is composed of several components. Concretely, the bone conduction speaker fixes the voice coil onto the bottom layer of the frame, makes the magnetic circuit vibrating upward and downward among the yoke, the magnetic bar and the overhead plate and is installed with the vibration contact part on the upper end of the magnetic circuit for transmitting sound oscillations to outside. Hence, it can vibrate bones around human skull directly, stimulate audition nerves through the bone conduction and finally makes sound heard.

Hereinafter, the subminiature bone conduction speaker of the present invention will be more clearly described referring to accompanying drawings.

**FIG. 1** depicts a plane figure of subminiature bone conduction speaker described in Preferred Embodiment of the present invention; and **FIG. 2** depicts a sectional view of **FIG. 1** illustrated across the line II - II.

As shown in **FIG. 1** and **FIG. 2**, the subminiature bone conduction speaker (10) of the present invention has a cylinder shape preferably as depicted in Preferred Embodiment. It contains the frame (12) which  
5 forms the side layer and the overhead layer of the bone conduction speaker (10) and is fixed up with the circular base plate (14) on its open inner bottom side (12). On the contrary, the bottom layer of the frame (12) can be made of the base plate (14). Thus, the  
10 frame (12) and the base plate (14) limit a certain space.

On the outside of the bottom surface in the base plate (14), the electrode terminal plate (11) is installed in order to receive licensed currents from  
15 the external providers of electric power (not depicted). One end of the coil (13) is fixed on the electrode terminal plate (11) by brazing, the coil (13) is extended to the inside of the bone conduction speaker (10) through the base plate (14) and the other end of  
20 the coil (13) extended above is connected with the lower end of the voice coil (30) which is fixed and stood on the base plate (14) within the bone conduction speaker (10). Once currents are licensed from external providers of electric power to the electrode terminal  
25 plate (11) and provided from the electrode terminal plate (11) to the voice coil (30) through the coil (13), the voice coil (30) induces changes of magnetic system

by using electric energy of voice signals.

On the circular aperture part (not noted symbols of figure) formed in the center of the overhead layer (12a) of the frame (12), the mastoid (16), a vibration  
5 contact part keeping contact directly with a part of human head, is fixed and installed. The mastoid (16) is protruded upward against the overhead layer (12a) of the frame (12) and makes a smoothly curved shape with certain curvature, considering the contact with the  
10 part of human head.

In the border line of the overhead layer (12a) of the frame (12) and the side layer (12c), the shoulder (12b) is arranged to form stairs in a radiational style and on the inner surface of the shoulder (12b) and the  
15 overhead surface of the base plate (14) within the bone conduction speaker (10), the bushing (18) is installed vertically and the damper (20) horizontally. The bushing (18) is a thin cylinder which is inserted to the inner surface of the side layer (12c) and sustains  
20 oscillations of the damper (20) stably when the bone conduction speaker (10) works. The outer surface of the bushing (18) has a close contact with the inner surface of the side layer (12c) of the frame. The bushing (18) supports radiational ends of the damper (20) which is  
25 arranged toward a cross direction within the bone conduction speaker (10). The damper (20) reduces the amplitude of oscillations and sounds by scattering

energies and the other end of the damper (20) is supported by the shoulder (22b) of the yoke (22) situated in the center of the bone conduction speaker (10).

5           The yoke (22) is a case that can concentrate magnetic flux in the bone conduction speaker (10) and made of cast iron and cast steel. The yoke (22) is arranged in the inner space (S) which is determined by the base plate (14), the bushing (18) and the damper  
10       (20). In the inner space (S), the yoke (22) is composed of a body part (22a) inserted into the assembling aperture (not noted a symbol of figure) formed in the center of damper (20) and one body with the body part (22a) and has the extension part (22d) elongated  
15       downward.

          On the inside of the radiation in the extension part (22d) of the yoke (22), the circular magnetic bar (24) and the overhead plate (26) are placed. The magnetic bar (24) and the overhead plate (26) comprise  
20       a magnetic circuit with the yoke (22). The overhead surface of the magnetic bar (24) has a close contact with the bottom surface of the body part (22a) in the yoke (22) and the bottom surface of the magnetic bar (24) has a close contact with the overhead surface of  
25       the overhead plate (26). In the space (G) formed with among the overhead plate (26), both ends of the magnetic bar (24) and the inside of the extension part

in the yoke (22), the voice coil (30) is placed as illustrated above.

On the other hand, the adapter (28) is installed in between the upper surface (22c) of the yoke (22) and the inside of the mastoid (16) in order to fix and support the mastoid (16). In the bone conduction speaker (10), the adaptor (28), the yoke (22), the magnetic bar (24) and the overhead plate (26) are arranged vertically and orderly and crossing their centers, the assembling apertures (not noted symbols of figure) are perforated. Then the eyelet (32) with a tube shape is inserted as an iron decoration, joined by pushing both ends of the eyelet (32) and then fixed to one body.

#### PREFERRED EMBODIMENT

Practical and presently preferred embodiments of the present invention are illustrated as shown in the following Preferred Embodiment.

However, it will be appreciated that those skilled in the art, in consideration of this disclosure, may make modifications and improvements within the scope of the present invention.

Hereinafter, the present invention will describe the subminiature bone conduction speaker (10) in detail

at the viewpoint of operations.

Once currents are licensed from external providers of electric power to the electrode terminal plate (11) and provided along the coil (13) from the electrode terminal plate (11) to the voice coil (30),  
5 the voice coil (30) induces changes of magnetic system by using electric energy of voice signals. That is, if currents are licensed toward the voice coil (30), magnetic field is generated between the magnetic bar  
10 (24) and the voice coil (30) which is arranged in the space (G) of magnetic circuit consisting of the overhead plate (26), the magnetic bar (24) and the yoke (22). As a result, Fleming's left hand principle comes into existence.

15 In that case, the voice coil (30) is fixed and the magnetic field which is built up cooperatively among the voice coil (30), the overhead plate (26), the magnetic bar (24) and the yoke (22) works for attractive force and repulsive force. Then, the  
20 magnetic circuit which is composed of the overhead plate (26), the magnetic bar (24) and the yoke (22) and jointed to one body vibrates upward and downward. At this point, the damper (20) installed in the upper end of yoke (22) prevents free oscillations of the magnetic  
25 circuit, which makes the oscillations sustained constantly. This vibration is transmitted through the mastoid (16) to a part of human head touched with the

mastoid (16). As a result, the vibration power is obtained to help sound heard through the bone conduction.

## 5     INDUSTRIAL APPLICABILITY

As demonstrated above, the subminiature bone conduction speaker of the present invention has distinct features from conventional bone conduction oscillators as described preferably in Preferred Embodiment. It fixes the voice coil (30) onto the base plate (14), makes a magnetic circuit vibrating upward and downward among the yoke (22), the magnetic bar (24) and the overhead plate (26) and is installed with the mastoid (16) on the upper end of the magnetic circuit for transmitting sound oscillations to outside. Thus, the subminiature bone conduction speaker can vibrate bones around human skull directly and stimulates auditory nerves through bone conduction in order to help sound heard for hearing-impaired people as well as normal human beings. In addition, the bone conduction speaker of the present invention can be applied to various fields such as mobile phone, wireless phone, earring-type mobile phone, telephone and the like since it can be made a subminiature easily and keeps communication private by reducing sound discharges toward outside.

Those skilled in the art will appreciate that the conceptions and specific embodiments disclosed in the foregoing description may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present invention. Those skilled in the art will also appreciate that such equivalent embodiments do not depart from the scope of the invention as set forth in the appended claims.

10



**What is claimed is:**

1. A bone conduction speaker which comprises:

5 a frame which is composed of an overhead layer, a side layer, a bottom layer and a shoulder forming stairs in a radiational type between said overhead layer and said side layer and limits a certain space;

10 a vibration contact part which is installed in a central aperture part, protruded to upside against said overhead layer and touches a part of human head directly;

15 a bushing which is arranged vertically on the inner surface of said shoulder and the overhead surface of said bottom layer and inserted to the inner surface of said side layer;

20 a damper which is arranged between the inner surface of said shoulder and the overhead surface of said bushing with its radiated ends, is supported with said bushing, vibrates stably and reduces oscillations or sound amplitude;

25 a yoke which is arranged within said space, makes one body with a body part inserted into an assembling aperture formed in the center of said damper, is equipped with an extension part elongated downward, supports the other end of said damper through said shoulder formed in said body part and concentrates magnetic flux;

a magnetic bar which is arranged inside of radiated region in said extension part and has a close contact between its overhead surface and the bottom surface of said body part;

5           an overhead plate which is arranged inside of said extension part, composed of a magnetic circuit with said yoke and said magnetic bar and has a close contact between its overhead surface and the bottom surface of said magnetic bar; and

10           a voice coil which is arranged in a space constructed with said overhead plate and both ends of said magnetic bar and the inner surface of said extension part and fixes its lower end on said bottom layer.

15

2.       The bone conduction speaker according to claim 1, including an adaptor which is arranged in between the uppest surface of said yoke and the inner surface of said vibration contact part and supports said  
20 vibration contact part for the fixation.

3.       The bone conduction speaker according to claim 2, in which an electrode terminal is made onto the outer bottom surface of said bottom layer in order to  
25 receive currents from external providers of electric power, one end of coil is brazed in said electrode terminal, said coil is extended to inside of said bone

conduction speaker across said bottom layer, and the other end of said coil is connected to the lower end of said voice coil.

- 5     4.   The bone conduction speaker according to claim 3, in which:

          said adaptor, said yoke, said magnetic bar and said overhead plate are arranged vertically and orderly, assembling apertures are perforated crossing  
10   their centers respectively, and an eyelet with a tube shape is inserted as an iron decoration and joined by pushing both ends of said eyelet to be fixed to one body;

          Once currents are licensed from external  
15   providers of electric power to said electrode terminal and provided along the coil (13) to said voice coil, in the fixed state of said voice coil, magnetic field built up cooperatively among said voice coil, said overhead plate, said magnetic bar and said yoke works  
20   as an attractive force and a repulsive force, said magnetic circuit vibrates upward and downward and said damper represses free oscillations of said magnetic circuit to sustain them consistently; and

          said oscillations are transmitted to a part of  
25   human head touched with said vibration contact part through said vibration contact part.

1/2

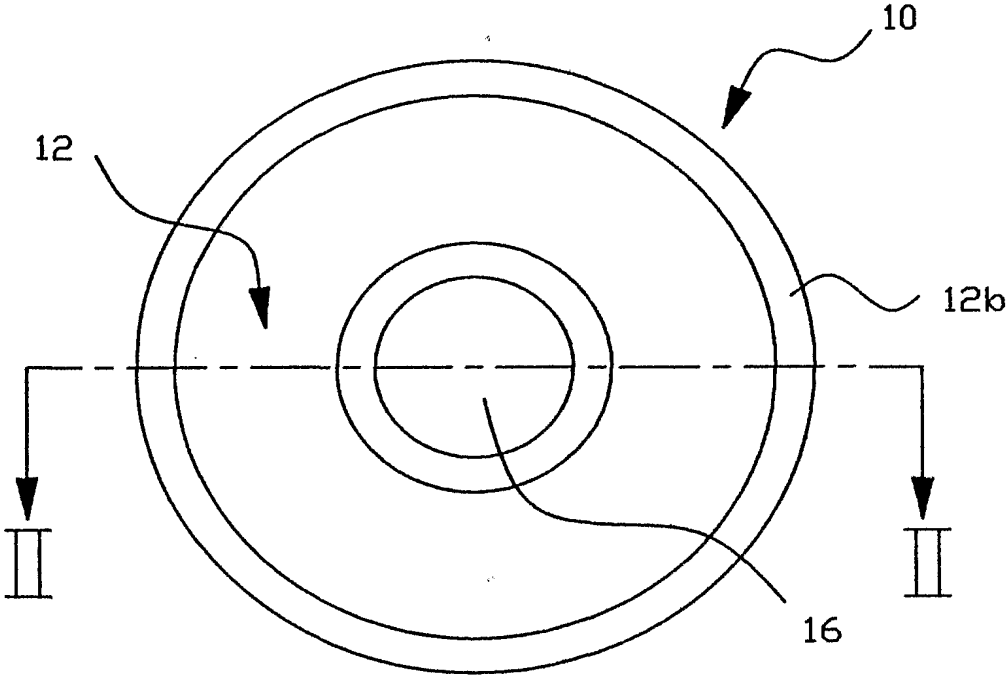


Fig. 1

2/2

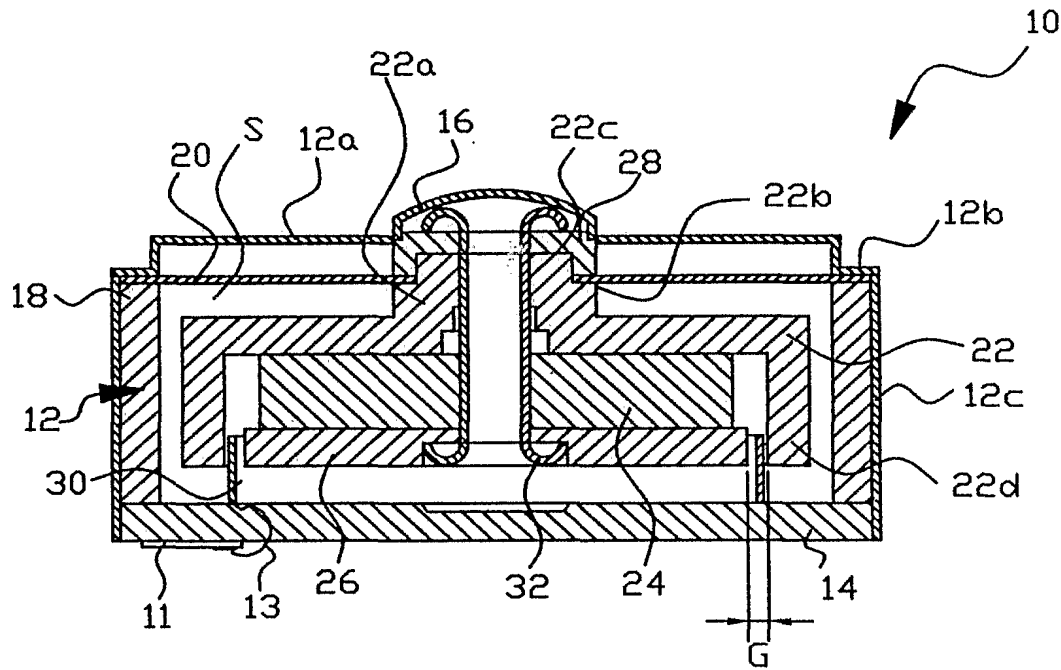


Fig. 2

## INTERNATIONAL SEARCH REPORT

national application No.  
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> <b>IPC7 H04R 1/00</b> According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC7 H04R 1/00, H04R 5/033  Documentation searched other than minimum documentation to the extent that such documents are included in the files searched Korean Patents and applications for inventions and Korean Utility models and applications for Utility models since 1975 Japanese Utility models and applications for Utility models since 1975  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
P, X	KR 2001-3562 A (Kim, Si-Young) 15 January 2001	1 - 4		
A	KR 1999-46111 A (Park, Seung-Gil) 25 June 1999	1 - 4		
P, A	KR 2001-3563 A (Kim, Si-Young) 15 January 2001	1 - 4		
<div style="display: flex; justify-content: space-between;"> <span><input type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input type="checkbox"/> See patent family annex.</span> </div>				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; border: none;">           * Special categories of cited documents:            "A" document defining the general state of the art which is not considered to be of particular relevance            "E" earlier application or patent but published on or after the international filing date            "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)            "O" document referring to an oral disclosure, use, exhibition or other means            "P" document published prior to the international filing date but later than the priority date claimed         </td> <td style="width: 50%; vertical-align: top; border: none;">           "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention            "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone            "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art            "&amp;" document member of the same patent family         </td> </tr> </table>			* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
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**DERWENT-WEEK:** 200252

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**TITLE:** Subminiature bone conduction speaker vibrates  
bones around human skull directly and stimulates  
auditory nerves through bone conduction

**INVENTOR:** HAN S

**PATENT-ASSIGNEE:** HAN S[HANSI]

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**PATENT-FAMILY:**

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MZ NL OA PT SD SE SL SZ TZ UG ZW

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<b>TYPE</b>	<b>IPC DATE</b>
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CIPS	H04R11/02 20060101

**ABSTRACTED-PUB-NO:** WO 0225989 A1**BASIC-ABSTRACT:**

**NOVELTY** - The speaker contains a frame (12) which forms the side layer and the overhead layer of the speaker and is fixed up with a circular base plate (14). A voice coil (30) is fixed and stood on the base plate. Once currents are licensed from external providers of electric power to the electrode terminal plate (11) and provided from the electrode terminal plate to the voice coil through a coil (13), the voice coil induces changes of magnetic system by using electric energy of voice signals.

**DESCRIPTION** - A mastoid (16), a vibration contact part keeps contact directly with a part of human head.

**USE** - For hearing-impaired or old people, and can also find application in mobile phone, wireless phone, earring-type mobile phone, telephone and the like.

**ADVANTAGE** - The speaker can be subminiaturized easily and improves conventional bone conduction speakers. Communication is kept private by reducing sound discharge toward outside.



DESCRIPTION OF DRAWING(S) - The drawing depicts a sectional view of the subminiature bone conduction speaker.

Electrode terminal plate (11)

Frame (12)

Coil (13)

Base plate (14)

Mastoid (16)

Voice coil (30)

**CHOSEN-DRAWING:** Dwg.2/2

**TITLE-TERMS:** SUBMINIATURE BONE CONDUCTING SPEAKER  
VIBRATION HUMAN SKULL STIMULATING  
AUDITORY NERVE THROUGH

**DERWENT-CLASS:** S05 V06

**EPI-CODES:** S05-F01; V06-C; V06-E01A; V06-G09;

**SECONDARY-ACC-NO:**

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